

# Pro-Bot Robotics



***Terrapin Software***

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## What is Pro-Bot and what can you do with it?



Pro-Bot is a full-fledged turtle robot with Logo on board. Like a car, which it appears to be, Pro-Bot can move forward and back and turn left and right. Pro-Bot can also do much more. The built-in pen mechanism allows it to draw as it goes. Capability to repeat and follow a series of commands, including a main program and sub-programs, makes Pro-Bot a hands-on responsive tool for teaching and learning programming. Built-in touch, light, and sound sensors give Pro-Bot the ability to respond to its environment, making it a great platform for teaching the basics of robotics. Whether you want to learn about programming, experience robotics, or just have fun, Pro-Bot is a great tool.

Pro-Bot can

- Move according to a series of commands in specified distances and degrees
- Display its program, highlighting each command as it is followed
- Store and incorporate sub-programs into a main program
- Draw as it moves with standard pens
- Respond to feedback from touch, sound, and light sensors

With Pro-Bot you can

- Control a robot
- Write programs and watch them in action
- Teach a robot to navigate its environment
- Have fun!

## Getting Started with Pro-Bot

**Batteries** Pro-Bot arrives from Terrapin with batteries installed and is ready to go. Pro-Bot operates on three AA batteries. Alkaline batteries are recommended, but either regular or rechargeable batteries may be used. In addition to the AA batteries which operate Pro-Bot motors, sounds, and sensors, Pro-Bot also has a backup battery that powers its memory. That means that all programs remain intact even when Pro-Bot is turned off and are available when Pro-Bot is turned on again.

**User Guide** The Pro-Bot *User Guide* that accompanies each Pro-Bot provides information on care and maintenance of the Pro-Bot and battery replacement.

**Switches** Pro-Bot has two on/off switches, located in the bottom left corner on the underside of the robot. The right switch is the on/off switch for Pro-Bot power. This power switch must be in the On position for Pro-Bot to operate. When the power switch is put in the On position, Pro-Bot's headlights blink once and the word "Main" appears at the top of the LCD display at the bottom right of the top side of the Pro-Bot.

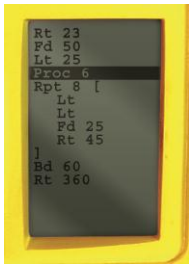
**Sound** The sound switch may be set optionally to Off or On. With the sound switch turned on, Pro-Bot clicks each time a button is pressed and honks its horn at the end of a series of commands. When the switch is off, Pro-Bot makes no sounds.

Pro-Bot comes ready to go with no assembly required. Though Pro-Bot is a sophisticated robot, Pro-Bot is friendly and makes it easy to get started. Turn on the power switch (and the sound switch too if your environment allows) and get ready to have fun!

## Teaching Pro-Bot to Move

**Arrow Keys** Pro-Bot is controlled by the buttons on the back left side of the car. Once the Pro-Bot power switch is turned on, you can begin to command the robot using just arrow keys and the GO button. Simply press the Forward or Back, Left or Right arrow keys to enter commands that tell Pro-Bot to move in the direction you want.

When using arrow keys alone, Pro-Bot moves forward and back in 15 centimeter increments (approximately 6 inches). Pro-Bot turns left and right 90 degrees at a time. When just arrow keys are used, Pro-Bot moves just like Bee-Bot.



**Screen** As you press the buttons, watch the screen on right of the keypad, where the first line displays `Main` (for Main procedure). You will see that the command represented by the arrow key you press appears on the screen as you press the key: `Fd` for Forward, `Bd` for Backward, `Lt` for Left, and `Rt` for right. When you have entered all the movements you want Pro-Bot to follow, just press the GO button and watch Pro-Bot execute your series of commands. As each command is executed, it is highlighted on the Main command screen so you can watch as the Pro-Bot follows your program.

**Scrolling** Pro-Bot can remember up to 128 commands at a time so you can develop quite an extensive route for the robot to follow. The Pro-Bot screen can display up to 16 lines. This includes the title `Main` indicating this is the main program and up to 15 lines of commands. If you enter more than 15 commands, the first command in the list “scrolls up” and disappears and the new command appears at the bottom of the list. This process continues as you enter more commands, with the first command displayed in the list disappearing when the last command entered appears at the bottom of the list.

Though some of the commands in the Main program may not appear on the display, they are still in Pro-Bot’s memory. When you press the GO button, Pro-Bot follows the entire Main program, beginning with the first command, whether or not it is displayed when GO is pressed. If the first command(s) is not displayed when GO is pressed, Pro-Bot changes the display to highlight the first line of the program. The highlight then moves through each line of the program as Pro-Bot executes it. If the Main program has more than 15 lines of commands, the top line scrolls off the screen when the last visible command is executed. The next line appears at the bottom of the screen and is highlighted while Pro-Bot executes that command.

That process repeats until all commands in the Main program have been executed. When the Main program has concluded, the screen displays the first 15 lines of the program and the highlight returns to the first line in the list. Pro-Bot is ready to GO again.

**Try it:** Sending Pro-Bot along a square or rectangular route. What commands would you enter?

## Changing the Commands

**Navigating the Program** Pro-Bot's Main screen not only displays the commands you have entered and highlights them as they are executed, but makes it simple to change a series of commands after they have been entered to refine a route. When the commands are displayed on the Main screen, the up and down arrow keys at the top right of the screen to the right of Menu may be used to move the highlight up and down through the series of commands.

**Insert or Delete Commands** To remove a command from the list, highlight that command and press the Clear button on the bottom right of the keypad below the "3" key to delete the command. To insert a command in the program, highlight the command before where you want to enter a new command. Press the key for the new command and it is inserted in the list **below** the highlighted command.

**Try it:** Send Pro-Bot along a square route. Then insert commands to change the route from a square to a rectangle.

**Clearing the Program** You may delete your program one line at a time by using the Clear key and pressing it once for each command line. You may also delete the entire program at once by holding the Clear key down for 3 seconds and then using the down arrow key to the right of Menu to select "Clr Main" from the list of commands that appears. Then press Menu to clear the Main program. The Main screen and the Pro-Bot's Main program memory is now empty and ready for a new series of commands to be entered.

**Stop Pro-Bot** If you need to stop Pro-Bot while it is following a program, press the GO key and Pro-Bot stops. Press GO again and the Main program is initiated from the beginning.

**Preserving Memory** When you turn Pro-Bot off, the current Main program is preserved and appears when the power switch is turned on again. Each time Pro-Bot is turned on, it is ready to go with the last Main program that was entered.

## Specifying Distance and Turns

**Using the Numeric Keypad** You can explore a great deal with Pro-Bot using the default movements of 15 centimeters and turns of 90 degrees. Pro-Bot is capable of following more nuanced and detailed routes since it also allows you to specify the distance it moves with each Forward (Fd) or Backward(Bd) command and the number of degrees it turns with each Left(Lt) or Right(Rt) command.

To do so, use Pro-Bot's numeric keypad to enter the distance or degrees you want after pressing the arrow key. After you press the Forward or Back arrow, the number you enter tells Pro-Bot how many centimeters to move. After you press the Left or Right arrow, the number you enter tells Pro-Bot how many degrees to turn.

**Try it:** Press the following sequence of keys to tell Pro-Bot to go forward 10 cm. and turn right 45°.

F 1 0 R 4 5

The following appears in the Main program window  
Fd10  
Rt45

Press GO and watch Pro-Bot do as you commanded. Add to that program or try another.

**Program Capacity** Pro-Bot can remember up to 128 commands so you can plan quite a route. (Note: The Main display shows 15 commands at a time, but can be used to scroll through the entire program.)

## Repeating

It can be tedious to enter a long series of commands, especially if you want Pro-Bot to repeat a set of movements and turns as part of its route. Pro-Bot makes it easy to repeat series of commands without entering them individually with its repeat function.

**Creating a Repeat Loop** There are four steps to tell Pro-Bot to repeat a series of commands:

- 1) Tell Pro-Bot to repeat by pressing the Rpt [ key.
- 2) Tell Pro-Bot the number of times to repeat by pressing the appropriate numeric key.
- 3) Tell Pro-Bot what to repeat by entering a series of commands.
- 4) Tell Pro-Bot you are finished with the sequence of commands to be repeated by pressing the ] key.

**Try it:** Think of a series of commands you would like to repeat. For example, you can use the repeat function to command Pro-Bot to follow the square route you did earlier, but can do so by entering fewer commands.

Start by pressing the “Rpt[“ key. The command appears on the Main screen as

```
Rpt [
```

Then press the number of times you would like Pro-Bot to repeat the commands you plan to enter. In the case of a square route, press the “4” key. The Main screen displays

```
Rpt4 [
```

For Pro-Bot to follow a square route, it must move either forward or back and left or right four times. Enter the combination of movement command (Fd or Bd) and turn command (Lt or Rt) you prefer. If you choose Fd and Rt, the screen displays

```
Rpt4 [  
Fd  
Rt
```

To confirm that you have completed the repeat sequence, press the “]” key. The screen will display

```
Rpt4 [  
Fd  
Rt  
]
```



**Highlighting a Repeat Loop** Press GO and Pro-Bot will move in a square route. The command that Pro-Bot is currently following is highlighted on the Pro-Bot screen. In a repeat command the highlight moves through the series of commands starting with the first after the [. When it finishes with the last command in the list, just before ], the highlight jumps back to the first command in the list. This process repeats the number of times specified in the repeat command.

**Concluding a Repeat Loop** You must conclude the series of commands that you want Pro-Bot to repeat by pressing the ] key. If you neglect to press the ] key after entering commands you want to repeat and then press GO, Pro-Bot executes the series of commands only once and then stops since the closing ] is required for Pro-Bot to know to repeat the commands. In this case, use the arrow keys to move the cursor to the last command in the repeating sequence and press the ] key. The closing ] is inserted after the last command. Subsequently, when you press GO, the series of commands between [ and ] are repeated the specified number of times.

## Developing Programs

**Translating a Program into Pro-Bot Commands** Programming Pro-Bot is as simple as pressing keys on the Pro-Bot keypad. Getting Pro-Bot to do exactly what you want requires deciding the route you want Pro-Bot to follow, breaking it down into specific Pro-Bot commands, measuring the distances and turns, and finally entering this information into Pro-Bot by pressing the corresponding keys.

For example, if you want Pro-Bot to move in a square, you need to analyze the structure of the square and translate that into commands Pro-Bot can understand. A square has four sides of equal length, so Pro-Bot must make four forward (or back) movements of equal distance. The distance you decide on determines the size of the square.

A square has four corners so the Pro-Bot must turn left (or right) four times. Since each corner of a square is a right or 90 degree angle, Pro-Bot must turn 90 degrees each time.

**Try it:** To command Pro-Bot to follow a square route of 25 steps on a side, you enter the same movement and turn commands four times

```
F 25 R 90 F 25 R 90 F 25 R 90 F 25 R 90
```

and then press GO.

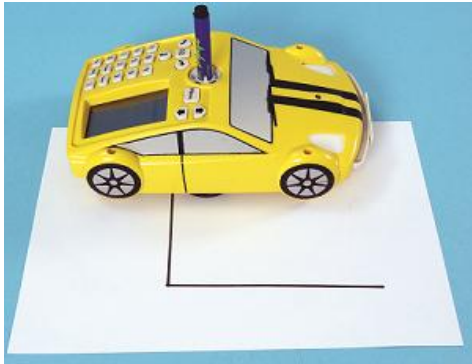
Since a square requires the same two commands to be executed four times sequentially, you could alternately enter the commands once using the repeat function

```
Rpt[ 4 F 25 R 90 ]
```

And then press GO.

**Programming Sequence** Follow the same process for any route you want Pro-Bot to follow. Decide on the route you want and the length of Pro-Bot's forward and back movements and the number of degrees for Pro-Bot to turn. Then enter this information in the Main program by entering it on the Pro-Bot's keypad. Press GO to watch Pro-Bot carry out your commands.

## Drawing



**Pen Mechanism** Pro-Bot has a pen mechanism which holds a standard felt-tip pen enabling Pro-Bot to draw as it moves. This allows Pro-Bot to leave a written record of its route as it moves which makes it easy to analyze the program and decide on changes and refinements. The pen mechanism also allows Pro-Bot to be used as a drawing mechanism to make interesting shapes and pictures.

**Raising and Lowering Pen** Pro-Bot's pen mechanism is in the middle of Pro-Bot and is marked `Down` and `Up` with two small handles that allow it to be turned. The pen is in the

middle of Pro-Bot's wheels which means Pro-Bot pivots around the pen when it turns. Pro-Bot draws when it moves forward and back but does not draw when it turns.

**Preparing to Draw** To draw with Pro-Bot first prepare the drawing area by locating a large sheet or roll of paper on a hard surface and locate a felt tip marker of the color you prefer. Raise the Pro-Bot pen mechanism to the up position by turning it counter-clockwise so that the handles are aligned with the direction of Pro-Bot. Remove the cap from the marker and gently insert the pen. Lower the pen mechanism by turning it clockwise until the pen drops into place, so that the point is touching the paper.

With the pen in place, Pro-Bot draws as it follows the Main program you have entered.

**Remove or Change Pen** To remove the pen or exchange a pen of one color for another, raise the pen mechanism to the up position by turning it counter clockwise and gently remove the pen by pulling it up. Insert another pen if desired, and lower the pen mechanism.

**Operating without a Pen** If no pen is inserted, the pen mechanism may be in the up or down position and does not affect how Pro-Bot operates.

## Pro-Bot Menu

So far, you have entered commands directly into Pro-Bot's Main program by using the Pro-Bot keypad. Pro-Bot has many additional functions that are accessible through its Menu system. Like a restaurant menu, the Pro-Bot Menu offers choices for you to pick, depending on what you want.

**Access the Menus** Access the Pro-Bot menu by pressing the key labeled `Menu` to the right of the pen mechanism. The up and down arrow keys to the right of `Menu` are used to choose the menu option you want. Pressing the up arrow moves the highlight cursor up one item in the current menu display. Pressing the down arrow moves the highlight cursor to the next item in the current menu display. Once the desired item is highlighted, press `Menu` to select it.

**Menu Levels** As you move through the menu system, the Pro-Bot display shows the options for that level in the menu. In each case, the first line displayed is the title of the current menu section. The second line displayed is `Back`. Selecting `Back` and pressing `Menu`, moves up one level in the menu system, back to the screen from which the current option was selected.

**Toplevel Menu** When the Main program displays and Menu is pressed, the following options are available.

Menu - indicates the Toplevel Menu  
Back - up one menu level; from the Toplevel Menu returns to the Main program  
New Proc - enters the new procedure menu  
Edt Proc - enters the edit procedure menu  
Config - enters the configuration menu  
Sensors - enters the sensors menu  
Clear - enters the clear menu

## Special Commands Menu

**Access Special Commands Menu** Commands to control Pro-Bot's lights and sounds are available through the Special Commands Menu. To access the Special Commands Menu, press and hold Menu for two seconds. The Special Commands Menu appears.

**Insert Special Commands** Special commands may be included in either the Main program or a sub-procedure. To insert a special command in your program or sub-procedure, access the Special Commands Menu from the line where you would like the command. To do so press the Menu for two seconds, then use the arrow keys next to Menu to scroll through the special command list. Position the highlight on the command you want to insert. Press Menu and the command is inserted in the Main program or the sub-procedure. The screen then displays the program with the command inserted.

**Special Commands Available** The commands available in the special commands menu are

Light On - turns the headlights on  
Light Off - turns the headlights off  
Sound 1 - plays the "switch on" sound  
Sound 2 - plays the "button click" sound  
Sound 3 - plays the "car horn" sound  
Sound 4 - plays the "data transfer" sound  
Sound 5 - plays the "transfer complete" sound  
Sound 6 - plays the "error" sound  
Sound 7 - plays the "go to standby" sound  
Pen Up - has no effect  
Pen Down - has no effect

## Developing Sub-Procedures

The Main Pro-Bot program is the series of commands Pro-Bot follows when you press GO. Each time you turn Pro-Bot on, the most recent Main program appears. Add to or change the Main program by following the steps to edit or delete a Main program and change what Pro-Bot does when GO is pressed.

**Create and Store Sub-Procedures** It is often useful to have Pro-Bot remember a series of commands you would like to use in different Main programs. This can be done by creating sub-

procedures or programs that are stored in Pro-Bot's memory. The series of commands in a sub-procedure are executed by Pro-Bot when the sub-procedure is called by the Main program.

**Expand the Main Program** You can also expand your Main program by including sub-procedures. A Main program may have up to 128 commands. A sub-procedure can itself have up to 128 commands. Calling a sub-procedure from the Main program is only one command in the Main program but Pro-Bot follows all the commands in the sub-procedure before returning to the next line in the Main program. Including sub-procedures allows you to greatly expand the number of commands that may be included in a Pro-Bot program.

**Sub-Procedure Names** Pro-Bot has the capability to remember up to 32 sub-procedures that you can define. Each of these sub-procedures is identified by the word `PROC` (for procedure) followed by its number. For example, `Proc1` is the first procedure in the Menu list, `Proc2` is the second procedure in the Menu list, and so forth to `Proc32`. To show the available sub-procedures, press `Menu`, use the down arrow to highlight `New Proc`, and press `Menu` again.

**Scrolling through Sub-Procedures** The list of sub-procedure names appears. The first line in the list is `New Proc`, indicating that Pro-Bot is ready for you to enter a new sub-procedure. The second line in the list is `Back`. Selecting `Back` and pressing `Menu` takes you back one level in the menu system. The Pro-Bot screen displays up to 16 lines at one time. There are more sub-procedures than can be displayed at once. You can scroll the highlight through the list of sub-procedures by pressing the up and down arrow keys next to `Menu`. When the last line in the list is highlighted and you press the down arrow, the next line appears and the first line in the list scrolls off the top of the screen. When `Back` is highlighted and you use the up arrow to move to the previous line, it appears below `Back` and the last line in the list scrolls off.

The title `New Proc` and `Back` are fixed on the screen and are always present when you scroll up and down through the entire list of sub-procedures. If you highlight `Back` and press the up arrow key, the previous line in the list appears and the last line in the list scrolls off the screen. If you highlight `Back` and press `Menu`, you will move up one level in the Pro-Bot menu structure.

**Try it:** Create a sub-procedure that causes Pro-Bot to move in a square route. First, clear the Main program. Then from the Main display, press `Menu`. Press the down arrow key to select `New Proc`. Press `Menu` to enter the new sub-procedure menu section. Press the down arrow key to select `Proc1` and then press `Menu` to select that sub-procedure.

Enter the commands for Pro-Bot to follow a square route. You can enter

```
Rpt [  
4  
F  
R  
]
```

When you have entered the commands for Pro-Bot to follow a square route, press `Menu` to define `Proc1`. This returns you to the Main program. Test your new procedure by using it as a command in the Main program. To do so, press `Proc` followed by `1`, which is the number of the sub-procedure that you defined. The screen displays

Main  
Proc1

Since the commands to direct Pro-Bot along a square route are contained in `Proc1`, this is a sufficient Main program to make Pro-Bot trace a square. Try it out by pressing `GO`.

**From Main Program to Sub-Procedure** When Pro-Bot encounters a sub-procedure command, it moves from the commands in the Main program to the commands in the sub-procedure. When that happens, the display changes from the Main program to show the commands in the sub-procedure. The title of the display changes from “Main” to the name of the sub-procedure. As Pro-Bot executes the sub-procedure commands, the display highlights each command as it is executed. When the sub-procedure concludes, control returns to the Main program which the display once again displays, highlighting the command in the Main program currently being executed.

**Mixing Sub-Procedures and Direct Commands** In the Main program, you can mix sub-procedures with direct commands. For example, to make Pro-Bot trace a flag shape, you can tell Pro-Bot to move forward and then follow a square route. Do so by editing the Main program and inserting a forward instruction prior to the sub-procedure that tells Pro-Bot to follow a square route. Use the up arrow key to locate the highlight on `Main`. Press `F`. `Fd` is inserted after `Main` and prior `Proc1`. Press `GO`. Pro-Bot moves forward and then follows the commands in `Proc1`.

**Try it:** Try making the “flagpole” section of the route longer by editing the Main program and extending the forward distance that Pro-Bot travels before following the square route specified by `Proc1`.

## Editing Sub-Procedures

**Selecting the Sub-Procedure** Like the Main program, Pro-Bot sub-procedures may be edited. The editing process is similar to that for the Main program, but first you must enter Edit mode and choose the sub-procedure you would like to edit. To do so, press `Menu` and press the down arrow key to highlight `EdtProc`. Then press `Menu` to select edit procedure mode.

A list of sub-procedure names appears. Use the arrow keys to highlight the name of the sub-procedure you would like to edit. Then press `Menu` to edit the selected sub-procedure.

**Try it:** For example, most flags are rectangular in shape rather than square. You can change the program in `Proc1` by editing the commands so that they instruct Pro-Bot to follow a rectangular route rather than a square one.

**Edt Proc VS. New Proc** When you choose `Edt Proc` and choose the sub-procedure you want to edit, the current contents of the sub-procedure appear. When you choose `New Proc`, indicating that you want to create a new sub-procedure, any content of the sub-procedure you choose is erased so that you can write a new sub-procedure for that procedure number. Be sure to choose `Edt Proc` when you want to edit the contents of a sub-procedure and `New Proc` only when you want to erase the contents of a particular sub-procedure and create a new one.

## Specialized Sensor Sub-Procedures

The Pro-Bot has five specialized sub-procedures which correspond to inputs from its sensors. These are

33 FRONT  
34 REAR  
35 DARK  
36 LIGHT  
37 SOUND

**Executing Sensor Commands** The commands in each of these sub-procedures are executed when the condition of the corresponding sensor condition is met. When the sensor condition is met, the Main program is interrupted so that the commands in the corresponding sub-procedure are run. If there are no commands in the sub-procedure corresponding to the sensor, then the Pro-Bot does not respond to changes in the sensor condition.

**Storing Sensor Commands** Sub-procedures 33 FRONT and 34 REAR correspond to the front and rear bumpers of Pro-Bot respectively. Sub-procedures 35 DARK and 36 LIGHT correspond to light conditions perceived by the light sensor located in the middle of Pro-Bot's hood. Sub-procedure 37 SOUND corresponds to the sound sensor on the underside of Pro-Bot. Sensor sub-procedures may be created and edited in the same way as any sub-procedure.

## Turning Sensors On and Off

Pro-Bot sensors may be turned off and on but must be turned on for Pro-Bot to respond to them. Turning sensors off when they are not in use conserves battery power. Sensors are turned off by default but maintain their state once it is set.

**Toggling the Sensors** To turn the sensors on or off, press Menu. From the Toplevel menu, use the down arrow key to choose Sensors and press Menu to see the Sensor menu which shows each sensor state. The default Sensor menu is

```
Sensors
Back
TouchOff
SoundOff
LightOff
```

Each of the three types of sensors may be toggled between On and Off. Use the down arrow key to select the sensor whose state you would like to change. Press Menu to change the sensor's state. Pro-Bot toggles the sensor from Off to On or from On to Off and returns you to the Main program.

**Confirming Sensor State** To confirm that the sensor state has changed, press Menu, choose Sensors and note that the state of the sensor you selected has been toggled. Select Back to return to the Toplevel menu and select Back from there to return to the Main program.

**Try it:** For example, if `TouchOff` displays in the Sensor menu, Pro-Bot does not recognize either of its bumpers being triggered and will not run sub-procedure `33 FRONT` or sub-procedure `34 REAR` when the bumper is pressed. To activate the bumpers so that sub-procedure `33 FRONT` or `34 REAR` is run when the corresponding bumper is pressed, press `Menu` from the Main program. Use the down arrow key to choose `Sensors`. In the Sensor menu, use the down arrow key to highlight `TouchOff` and press `Menu`. The bumpers are activated and you return to the Main program

To verify that the Touch sensors are active, press `Menu`, choose `Sensors`, and press `Menu`. `Touch On` displays and the touch sensors are activated. Select `Back` and press `Menu` to return to the Toplevel menu where `Back` is highlighted. Press `Menu` again to return to the Main program.

## Touch Sensors

Pro-Bot contains touch sensors that are activated when the front or rear bumper is pressed. When the touch sensors are turned on and one of the bumpers is pressed, Pro-Bot interrupts the Main program to run the commands in the sub-procedure corresponding to the front or rear bumper.

**Try it:** Make Pro-Bot back up and turn when it encounters an object that presses the front bumper while it is moving forward. You need to send Pro-Bot forward in the Main program and then define “back up and turn” by entering commands in sub-procedure `33 FRONT`.

**Setting Up** First, be sure that the touch sensors are turned on. Then enter the commands you would like Pro-Bot to follow when the front bumper is triggered. Press `Menu`, choose `New Proc`, press `Menu`, choose sub-procedure `33 FRONT`, and press `Menu`. `33 FRONT` displays on the screen and you are ready to enter commands.

**Entering Commands** For Pro-Bot to go back 20 steps and turn right 90 degrees when it encounters an obstacle that presses the front bumper, press the back arrow and `20` followed by the right arrow and `90`.

**Starting a Main Program** Press `Menu` to return to the Main program. Use the Main program to tell Pro-Bot to move forward. For example, you can send Pro-Bot forward 100 steps by pressing the forward arrow followed by `100`. Press `GO` to start the Main program.

**Responding to a Bumper Press** Pro-Bot moves forward until it has completed 100 steps or encounters an object that presses the front bumper. When the front bumper is pressed, Pro-Bot suspends the Main program and follows the commands in sub-procedure `33 FRONT`. The screen switches from displaying the commands in the Main program to display the commands in sub-procedure `33 FRONT`. You can see each command is highlighted as it is executed. When Pro-Bot finishes all the commands in sub-procedure `33 FRONT`, it returns to the Main program and begins executing the Main program **from the beginning**.

**Programming the Back Bumper** Pro-Bot may be programmed to respond to the back bumper being pressed in a manner similar to that for the front bumper. Simply enter the commands you want Pro-Bot to follow when the back bumper is pressed in sub-procedure `34 REAR` rather than `33 FRONT`.

When Pro-Bot's bumper touch sensors are turned on, Pro-Bot responds to either the front or back bumper being pressed. The same or different commands may be entered in sub-procedures 33 FRONT and 34 REAR to define what Pro-Bot does in either case.

## Sound Sensor

Pro-Bot contains a sound sensor that detects short sharp sounds such as a hand clap, a short yell, or other loud sound. Pro-Bot only listens for sounds when the motors are not running so that the sound of the motors does not trigger the sound sensor. Pro-Bot may be programmed to respond to sounds when a Main program is running but the motors are not activated. This may be achieved by inserting pauses in a Main program.

**Activating the Sound Sensor** Pro-Bot's sound sensor must be activated for Pro-Bot to respond to sounds it detects. To activate the sound sensor, press Menu, use the arrow key to select Sensors, and press Menu to display the Sensors menu. If SoundOff appears in the Sensors menu, then use the arrow key to select it and press Menu. The sound sensor is turned on and the Main program appears. If Sound On appears in the Sensors menu display, then simply press Menu twice to return to the Main program screen.

**Try it:** Decide what you would like Pro-Bot to do when it detects a loud sharp sound. Enter the commands you would like Pro-Bot to follow in sub-procedure 37 SOUND.

To turn Pro-Bot 90 degrees when you clap your hands loudly, add that command to sub-procedure 37 SOUND. Press Menu and select New Proc. (If you choose Edt Proc, the current contents of sub-procedure 37 SOUND appear which you can change. If you choose New Proc, the current contents of sub-procedure 37 SOUND are erased and 37 SOUND appears blank. You can then add commands.) Use the arrow keys to select sub-procedure 37 SOUND and press Menu.

Enter commands to turn Pro-Bot 90 degrees by pressing the right arrow and then 9 0. When you are finished, press Menu to return to the Main program. Enter commands in the Main program to move Pro-Bot about. Be sure to enter pauses after the movement commands so Pro-Bot can listen for a sound.

For example, you can tell Pro-Bot to move forward 20 steps and then back 20 steps four times, pausing after each move. To do so enter

```
Rpt[ 4 F 2 0 Pause B 2 0 Pause ]
```

Press GO so Pro-Bot executes the program. During a pause, clap your hands loudly. On hearing the sound, Pro-Bot executes sub-procedure 37 SOUND and turns right 90 degrees. After completing sub-procedure 37 SOUND, Pro-Bot returns to complete the Main program at the point at which the sound occurred.

## Light Sensor

Pro-Bot contains a light sensor located in the middle of the hood that can sense when the ambient light changes. This allows Pro-Bot to be programmed to respond when going through a dark tunnel or when the lights in the room are turned off and then on again.



**Activate the Light Sensor** Pro-Bot's light sensor must be activated for Pro-Bot to respond to changes between light and dark. To activate the light sensor, press `Menu`, use the arrow keys to select `Sensors`, and press `Menu` to display the `Sensors` menu. If `LightOff` appears in the `Sensors` menu, use the arrow key to select it and press `Menu`. The light sensor is turned on and the `Main` program appears. If `Light On` appears in the `Sensors` menu, then simply press `Menu` twice to return to the `Main` program.

**Light and Dark Sub-Procedures** Two sub-procedures are reserved for defining how Pro-Bot responds to changes between light and darkness. Sub-procedure `35 DARK` holds commands that Pro-Bot executes when its environment becomes dark. Sub-procedure `36 LIGHT` holds commands that Pro-Bot executes when its environment changes from dark to light.

**Try it:** If you would like Pro-Bot to pause the `Main` program when the lights go out, you can enter one or more pauses in sub-procedure `35 DARK`. To do so, press `Menu` and use the arrow keys to select `New Proc.` Then use the arrow keys to select `35 DARK`. Enter one or more pauses in the sub-procedure by pressing `Pause` one or more times. Then press `Menu` to return to the `Main` program. If you have not yet entered a `Main` program, do so now.

Press `GO` to begin execution of the `Main` menu program. Turn the lights out. Pro-Bot pauses by following the commands in `35 DARK`. Pro-Bot returns to the `Main` program when the lights are turned on or all the pauses in `35 DARK` have been completed, whichever comes first.

If all you want is for Pro-Bot to return to the `Main` program when it emerges from darkness, there is no need to enter commands in sub-procedure `36 LIGHT`. If you want Pro-Bot to do something after it emerges from the dark and before it returns to the `Main` program, those commands may be entered in `36 LIGHT`. They are executed after Pro-Bot emerges from darkness before returning control to the `Main` program.

## Customizing Pro-Bot

Pro-Bot is highly adaptable and may be customized for different environments and situations.

**Sub-Procedures** Pro-Bot offers up to 32 sub-procedures that can be developed by the user. Each sub-procedure can hold a set of commands which are executed when that sub-procedure is called by the `Main` program. A set of commonly used tools in Pro-Bot programs can be developed and stored in Pro-Bot's memory so that they are available whenever Pro-Bot is in use. This lets you develop your own customized toolbox for Pro-Bot which is available whenever you need it.

**Decals** Pro-Bot comes with a set of decals with which the robot can be decorated. From numbers to wheel designs, the decals can be applied to Pro-Bot for a customized look.



## Attaching K'Nex Constructions

Pro-Bot comes with hexagonal slots to which standard K'Nex building set parts may be attached. This allows use of Pro-Bot as a mobile platform for constructions made with K'Nex parts. There are four K'Nex connecting slots on Pro-Bot, one each above each wheel well. For more information about K'Nex construction kits, visit [www.knex.com](http://www.knex.com).

## Troubleshooting

**Pro-Bot Beeps** When the Pro-Bot power switch is turned on, but Pro-Bot has not moved and no keys have been pressed for 3 minutes, Pro-Bot makes a distinctive sound and the Pro-Bot screen goes blank. This is a reminder that Pro-Bot is turned on and helps preserve battery life. If you no longer want to use Pro-Bot at the time, then turn off the power switch. If you want to continue using Pro-Bot, simply press any key and Pro-Bot comes back to life and is ready to go.

**Changing the AA Batteries** Pro-Bot's three AA batteries power its motors, lights, and sound. Sluggish Pro-Bot movement indicates the batteries may be weak. To replace the batteries, turn Pro-Bot over and locate the rectangular battery compartment toward the front of Pro-Bot's underside.

**Changing the CR2032 Battery** Pro-Bot's memory is powered by a CR2032 "watch" battery. This battery keeps Pro-Bot's memory active even when the power switch is turned off to maintain the contents of the Main program and all sub-procedures between Pro-Bot sessions. The CR2032 battery should last a year or longer. When the battery requires replacement, a message appears on the Pro-Bot screen when Pro-Bot is turned on.

To replace the CR2032 battery, turn Pro-Bot over and locate the battery compartment at the back of Pro-Bot's underside. The battery compartment has a small square door held in place by a metal screw. Use a screwdriver to loosen the screw and remove the door. Gently dislodge the battery with your finger or the flat edge of a small screwdriver. Insert the new battery by slipping it under the lip of the battery holder and pressing it into place. Replace the battery compartment door and screw it shut.

**Pro-Bot is Non-Responsive** When turned on, nothing displays on the screen of a non-responsive Pro-Bot and Pro-Bot does not respond to button presses. This indicates that Pro-Bot needs to be reset. Turn Pro-Bot over and find the small hole labeled Reset at the bottom left of the underside of Pro-Bot near the switches. Bend a paper clip so that one end sticks out or obtain a toothpick which fits in the hole. Be sure batteries with power are installed with the correct polarity. Turn Pro-Bot on. Gently push the end of the paperclip or the toothpick in the Reset hole. Pro-Bot beeps and springs back to life.